PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-347107

(43)Date of publication of application : 20.12.1994

(51)Int.Cl. F25B 1/00
B01L 7/00
B01L 11/02
F24F 11/02

(21)Application number : 05-137637

(22)Date of filing : 08.06.1993

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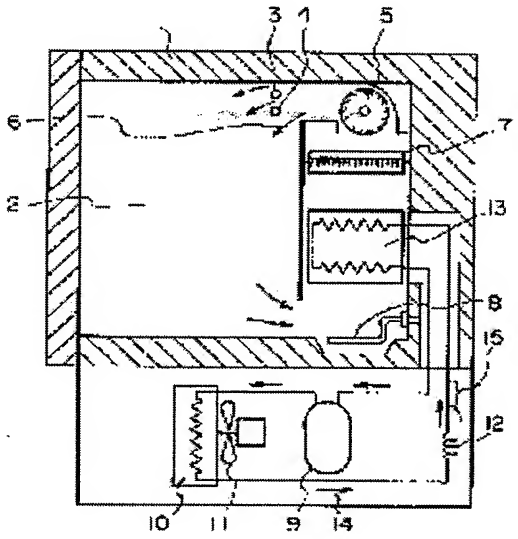
(54) METHOD OF CONTROLLING FREEZER AND CONTROL DEVICE FOR FREEZER FOR THERMO-HYGROSTAT

(57)Abstract:

PURPOSE: To prevent a disturbance in temperature control in a testing chamber caused by a variation in ambient temperature around a device, in particular, a reduction in performance of temperature where the device can reach its minimum value.

CONSTITUTION: A thermo-hygrostate is operated such that an adjusted temperature and an adjusted humidity are controlled by a heater 7 and a humidifier 8 installed within a chamber 2. Condensing means 10 and 11 and a pressure reducing means 12 are connected to an evaporator 13 installed within the chamber 2 through a compressor 9, and a freezer for use in cooling the inner region of the chamber 2 to a predetermined temperature. At this time, the compressor 9 making a cooling capability variable in response to a variation in the number of rotation in its operation is employed. There is provided a refrigerant evaporating temperature sensor 15. A frequency for changing the number of rotation of the compressor 9 is calculated and controlled in such a manner that the sensed temperature is kept at a constant target value of refrigerant evaporating temperature. With such an arrangement as above, it is possible to keep the refrigerant evaporating temperature at a constant temperature so as to be stabled and thus stabilization and high accuracy of a testing chamber temperature control can be realized.



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CLAIMS

[Claim(s)]
[Claim 1]warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was provided in said interior of a room based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed in said interior of a room via a compressor, and makes prescribed temperature cool said interior of a room, A freezer control method of a homoiothermal constant humidity device which inputs temperature and humidity of said interior of a room, sets up a desired value of a refrigerant state of said freezer, carries out revolving speed control of said compressor with an inverter according to a difference of this desired value and measured value of said refrigerant state, is provided with making refrigeration capacity variable, and is characterized by things.
[Claim 2]warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was provided in said interior of a room based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed in said interior of a room via a compressor, and makes prescribed temperature cool said interior of a room, A freezer control method of a homoiothermal constant humidity device which sets up a desired value of this refrigerant state beforehand according to a refrigerant state of said freezer, carries out revolving speed control of said compressor with an inverter according to this desired value, is provided with making refrigeration capacity variable, and is characterized by things.
[Claim 3]warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was provided in said interior of a room based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed in said interior of a room via a compressor, and makes prescribed temperature cool said interior of a room, A freezer control method of a homoiothermal constant humidity device inputting temperature and humidity of said interior of a room, setting up a desired value of a refrigerant state of said freezer, controlling an opening of said decompressing means formed by an electronic expansion valve according to a difference of this desired value and measured value of said refrigerant state, and making refrigeration capacity variable.
[Claim 4]A freezer control method of a homoiothermal constant humidity device of claim 1-3, wherein a refrigerant state is refrigerant evaporation temperature set as about 1 constant value of a refrigerant decompressed by a decompressing means given in any 1 paragraph.
[Claim 5]A freezer control method of a homoiothermal constant humidity device of claim 1-3, wherein a refrigerant state is the low pressure of a refrigerant inhaled by compressor given in any 1 paragraph.
[Claim 6]A freezer control method of a homoiothermal constant humidity device of claim 1-3, wherein a refrigerant state is the refrigerant condensation temperature of a refrigerant which

was breathed out from a compressor and condensed by a condensing means given in any 1 paragraph.
[Claim 7]A freezer control method of a homoiothermal constant humidity device of claim 1-3, wherein a refrigerant state is the high pressure of a refrigerant breathed out from a compressor given in any 1 paragraph.
[Claim 8]A freezer control method of a homoiothermal constant humidity device of claim 1-7, wherein a desired value of a refrigerant state is set up according to device ambient air temperature of a condensing means given in any 1 paragraph.
[Claim 9]In a refrigerating machine control device of a homoiothermal constant humidity device which applies a freezer control method of claims 1 and 2 or a homoiothermal constant humidity device of 4-8 given in any 1 paragraph, A refrigerating machine control device of a homoiothermal constant humidity device provided with a frequency control machine which carries out revolving speed control of the compressor to a control means with an inverter, and makes refrigeration capacity variable.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to a homoiothermal constant humidity device, especially carries out revolving speed control of the compressor of a freezer according to the temperature and refrigerant evaporation temperature in an accessory compartment, and relates to the freezer control method and refrigerating machine control device of a suitable homoiothermal constant humidity device to carry out stable maintenance of the temperature and humidity which supplied the optimal refrigeration capacity and were set up.
[0002]
[Description of the Prior Art]In the freezer control method of the conventional homoiothermal constant humidity device, In order to **** the thing of number-of-rotations regularity (immobilization) to the compressor of a refrigerating cycle and to switch cooling and dehumidification capacity to it, By having equipped two or more sort parallel with reduced pressure control and an evaporator, having accepted necessity, and pouring a refrigerant to one [a gap or] reduced pressure control and evaporator, it is common to adjust refrigeration capacity and there is JP,63-132252,U as a well-known example relevant to this kind of device.
[0003]For example, the homoiothermal constant humidity device which examines a semiconductor or an electronic device needs to maintain the refrigerant evaporation temperature of the refrigerating cycle below a suitable temperature gradient to the testing laboratory minimum temperature to attain this minimum temperature, although the minimum temperature as basic performance which can reach a testing laboratory was decided. When a capillary tube or a temperature type expansion valve is used for the reduced pressure control of a refrigerating cycle, device ambient air temperature is high, namely, the refrigerant condensation temperature by an air-cooled condenser is high like before, refrigerant evaporation temperature will also rise and it will go up from the minimum temperature which the maintenance of the minimum temperature in a testing laboratory becomes impossible, and was set up. However, if a capillary tube or the amount of decompression of a temperature type expansion valve is determined that required refrigerant evaporation temperature is obtained even when refrigerant condensation temperature is high in order to prevent this, When ambient air temperature is low and refrigerant condensation temperature is low, refrigerant evaporation temperature falls unusually and causes compressor damage due to a refrigerating-machine-oil temperature fall. Therefore, it is the important conditions of this kind of device to maintain the refrigerant evaporation temperature which is not influenced to change of device ambient air temperature, i.e., change of refrigerant condensation temperature, and to keep device performance constant through every year.
[0004]
[Problem(s) to be Solved by the Invention]If it was in the freezer control method of the conventional homoiothermal constant humidity device, refrigerant evaporation temperature changed with change of device ambient air temperature, i.e., change of the refrigerant condensation temperature of a compressor, and there was a problem which cannot keep device performance constant through every year.
[0005]The purpose of this invention maintains refrigerant evaporation temperature to about 1

constant value, even if device ambient air temperature changes, and there is in providing the freezer control method and refrigerating machine control device of a homoiothermal constant humidity device which can carry out air conditioning of the interior of a room.
[0006]
[Means for Solving the Problem]In order to attain the aforementioned purpose, a freezer control method of a homoiothermal constant humidity device concerning this invention, warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was indoors provided based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed indoors via a compressor, and makes prescribed temperature cool the interior of a room, An indoor temperature and humidity are inputted, a desired value of a refrigerant state of a freezer is set up, revolving speed control of the compressor is carried out with an inverter according to a difference of a desired value and measured value of a refrigerant state, and it has composition which makes refrigeration capacity variable.
[0007]and warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was indoors provided based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed indoors via a compressor, and makes prescribed temperature cool the interior of a room, Composition which sets up a desired value of a refrigerant state beforehand according to a refrigerant state of a freezer, carries out revolving speed control of the compressor with an inverter according to a desired value, and makes refrigeration capacity variable may be used.
[0008]warming which measured an indoor temperature and humidity which were surrounded by thermal insulation, and was indoors provided based on each measured value, while carrying out air conditioning control with a vessel and a humidifier, In a freezer control method of a homoiothermal constant humidity device which controls a freezer which connects a condensing means and a decompressing means to an evaporator formed indoors via a compressor, and makes prescribed temperature cool the interior of a room, Composition which inputs an indoor temperature and humidity, sets up a desired value of a refrigerant state of a freezer, controls an opening of a decompressing means formed by an electronic expansion valve according to a difference of a desired value and measured value of a refrigerant state, and makes refrigeration capacity variable may be used.
[0009]Furthermore, composition which is the refrigerant evaporation temperature set as about 1 constant value of a refrigerant decompressed by a decompressing means may be sufficient as a refrigerant state.
[0010]And composition which is the low pressure of a refrigerant inhaled by compressor may be sufficient as a refrigerant state.
[0011]Composition which is the refrigerant condensation temperature of a refrigerant which was breathed out from a compressor and condensed by a condensing means may be sufficient as a refrigerant state.
[0012]Furthermore, composition which is the high pressure of a refrigerant breathed out from a compressor may be sufficient as a refrigerant state.
[0013]And composition set up according to device ambient air temperature of a condensing means may be sufficient as a desired value of a refrigerant state.
[0014]In a refrigerating machine control device of a homoiothermal constant humidity device, it has composition provided with a frequency control machine which carries out revolving speed control of the compressor to a control means with an inverter, and makes refrigeration capacity variable in a refrigerating machine control device of a homoiothermal constant humidity device which applies a freezer control method of any said one homoiothermal constant humidity device.
[0015]
[Function]According to this invention, if the power supply frequency of a rotary compressor is changed, as shown by a number-of-rotations (r. p.m) =(120/p) xfp= pole and f= frequency, the

number of rotations of a rotary compressor will change in proportion to frequency. If number of rotations changes, the discharge quantity of a refrigerant will change, the amount of refrigerant circulation will change, and refrigeration capacity will change. For example, if frequency is made high and the number of rotations of a rotary compressor is raised although refrigerant evaporation temperature also becomes high when device ambient air temperature is high and the refrigerant condensation temperature of a freezer is high, the amount of refrigerant circulation will increase, refrigerant condensation temperature will fall, and predetermined refrigeration capacity will be acquired. Power supply frequency by carrying out the comparison operation of the measurement refrigerant evaporation temperature, and making target refrigerant evaporation temperature and measurement refrigerant evaporation temperature approximate to the target refrigerant evaporation temperature determined with an indoor measurement temperature inputted into a control means, The optimal refrigeration capacity is supplied, change of the refrigeration capacity accompanying change of the refrigerant condensation temperature by change of device ambient air temperature is controlled, and device performance is kept constant through every year.

[0016]

[Example]The 1st example of this invention is described referring to drawing 1. The testing laboratory (room) 2 where the homoiothermal constant humidity device was surrounded by the thermal break 1 as shown in drawing 1, The condensing means which consists of the rotary compressor 9 which circulates through the refrigerant 14, and in which frequency control is possible, and the fan 11 for condensers which ventilates the condenser 10 which carries out air quenching of the refrigerant gas breathed out from the rotary compressor 9 to a refrigerant solution, and the condenser 10, The reduced pressure control (decompressing means) 12 which decompresses the refrigerant 14, and the evaporator 13 which absorbs the heat in the testing laboratory 2 with the refrigerant 14 which was provided in the testing laboratory 2 and decompressed, the inside of the testing laboratory 2 -- warming -- warming to control -- it is constituted by the heater 7, the humidification heater 8 which carries out humidification control of the inside of a testing laboratory, the circulating blower 5 in the testing laboratory 2, and the control means which is not illustrated. The flow 6 of air circulates through the inside of the testing laboratory 2 like an arrow graphic display. The dry-bulb-temperature sensor 3 and the wet-bulb temperature sensor 4 are arranged at the outlet of the circulating blower 5, and the refrigerant-evaporation-temperature sensor 15 is further attached to the pipe-line way to the evaporator 13 by the refrigerant exit side of the reduced pressure control 12. The composition which carried the thing of constant speed and formed reduced pressure control by the electronic expansion valve may be sufficient as a compressor.

[0017]The control-system way (control means) of this device is explained referring to drawing 2. Each detection temperature of the dry-bulb-temperature sensor 3 and the wet-bulb temperature sensor 4, the microcomputer 20 performs a comparison operation with indoor preset temperature and setting-out humidity -- the heater output controllers 21 and 22 -- warming -- highly precise air conditioning control is enabled by carrying out PID control of the output signal to the heater 7 and the humidification heater 8. On the other hand, the refrigerating cycle used as an object for dehumidification cooling, Based on each detection temperature of the dry-bulb-temperature sensor 3 and the wet-bulb temperature sensor 4, the difference of setting out of the desired value of a refrigerant state, and the measured value of a refrigerant state, For example, the microcomputer 20 performs the comparison operation of the difference of the detection temperature and setting-out refrigerant evaporation temperature by the refrigerant-evaporation-temperature sensor 15, and PID control of the frequency for controlling the number of rotations of a rotary compressor by the frequency control machine 23 is carried out. The refrigerant condensation temperature of the refrigerant which the refrigerant state was breathed out from the low pressure of the refrigerant inhaled by the compressor, and a compressor, and was condensed by the condensing means, Or any of the high pressure of the refrigerant breathed out from the compressor may be sufficient, and desired values, such as setting-out refrigerant evaporation temperature, may be beforehand decided on the specification of a device according to an indoor temperature and humidity. Furthermore, a decompressing

means is formed by an electronic expansion valve, and a compressor carries the thing of constant speed and may be made to carry out opening control of the electronic expansion valve with a microcomputer.

[0018]The flow chart of the frequency control of a rotary compressor is shown in drawing 3. On initial-setting frequency, number of rotations changes according to change of power supply frequency, the amount of refrigerant circulation fluctuates, and a rotary compressor rotates simultaneously with the start up of a rotary compressor, and after this, The comparison operation of the difference of the measurement temperature of an evaporating temperature sensor and target refrigerant evaporation temperature is always performed, When measurement temperature is high, it is considered as the increase of frequency, and when low, it is considered as the decrease of frequency, and operation of the amount of increase and decrease which determines the optimal power supply frequency transmitted to a rotary compressor, makes measurement refrigerant evaporation temperature approximate to target refrigerant evaporation temperature, and is coincided further is further attained by carrying out PID control.

[0019]The 2nd example of this invention is described referring to drawing 4. Instead of the refrigerant-evaporation-temperature sensor in the 1st example, it is the composition of having used the refrigerating cycle low-pressure power sensor. By attaching the low pressure sensor 16 between the rotary compressors 9 via the reduced pressure control 12 and the evaporator 13, Like the comparison operation of the setting-out refrigerant evaporation temperature and detection temperature in the 1st example, the comparison operation of target low pressure and detection pressure power is performed, the frequency of a rotary compressor is controlled, and it becomes possible to make target low pressure and detection pressure power approximate.

[0020]The 3rd example of this invention is described referring to drawing 5. Instead of the refrigerant-evaporation-temperature sensor in the 1st example, it is the composition of having used the refrigerating cycle condensation temperature sensor. By attaching the refrigerant condensation temperature sensor 17 to the inside of the condenser 10, or the exit part of the condenser 10, refrigerant condensation temperature is detected and the frequency of the rotary compressor required in order to keep refrigerant evaporation temperature constant to refrigerant condensation temperature beforehand is set up. This example of control is shown in drawing 6. It becomes possible to keep refrigerant evaporation temperature constant by operating a rotary compressor according to the 3rd example with the set frequency according to change of the refrigerant condensation temperature accompanying change of device ambient air temperature.

[0021]The 4th example of this invention is described referring to drawing 7. Instead of the refrigerant condensation temperature sensor in the 3rd example, it is the composition of having used the refrigerating cycle high pressure sensor. The high pressure of a refrigerant is detected by attaching the high pressure sensor 18 between the rotary compressor 9 and the reduced pressure control 12, The same effect can be acquired by setting up frequency with the detected high pressure instead of the frequency setting of the rotary compressor by the detected refrigerant condensation temperature in the 3rd example.

[0022]The 5th example of this invention is described referring to drawing 8. The case where an air temperature sensor is used instead of the refrigerant condensation temperature sensor in the 3rd example is shown in drawing 8. By attaching the air temperature sensor 19 to a device periphery or the air-drawing part of the condenser 10, The same effect can be acquired by detecting air temperature (device ambient air temperature), and setting up frequency with the detected air temperature instead of the frequency setting of the rotary compressor by the detected refrigerant condensation temperature in the 3rd example.

[0023]By this invention, refrigerant evaporation temperature can be maintained and stabilized to target temperature to change of device ambient air temperature, i.e., change of refrigerant condensation temperature. The frequency control of a rotary compressor and an example of the refrigerating cycle characteristic by this invention are shown in drawing 9. Even if device ambient air temperature changes and refrigerant condensation temperature changes by adopting the frequency control by the refrigerant evaporation temperature of this invention, The refrigerant evaporation temperature can keep constant -45 ** which is setting-out refrigerant evaporation temperature, as a result, testing laboratory preset temperature-40 ** is maintained through

every year, and it becomes possible to maintain stability. Refrigerant evaporation temperature changes and it becomes impossible in the frequency immobilization (60 Hz) by conventional technology, for testing laboratory temperature to maintain −40 ** as a result to a device ambient temperature change at the time of a circumference elevated temperature, as a dashed line shows in drawing 9.

[0024]

[Effect of the Invention]According to this invention, since refrigerant evaporation temperature can be maintained and stabilized to target temperature to change of device ambient air temperature, i.e., change of refrigerant condensation temperature, indoor preset temperature is maintained with high precision through every year, and it becomes possible to stabilize.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a lineblock diagram showing the 1st example of this invention.
[Drawing 2]It is a flow chart which shows the control-system way of drawing 1.
[Drawing 3]It is a flow chart which shows the frequency control of the rotary compressor of drawing 1.
[Drawing 4]It is a lineblock diagram showing the 2nd example of this invention.
[Drawing 5]It is a lineblock diagram showing the 3rd example of this invention.
[Drawing 6]Refrigerant condensation temperature and setting-out compressor frequency by this invention example 3
[Drawing 7]It is a lineblock diagram showing the 4th example of this invention.
[Drawing 8]It is a lineblock diagram showing the 5th example of this invention.
[Drawing 9]It is a figure showing the compressor frequency control and the refrigerating cycle characteristic by this invention.
[Description of Notations]
3 Dry-bulb-temperature sensor
4 Wet-bulb temperature sensor
7 warming -- a heater
8 Humidification heater
9 Rotary compressor
10 Condenser
12 Electronic formula proportional control valve
13 Evaporator
14 Refrigerant
15 Refrigerant-evaporation-temperature sensor
16 Low pressure sensor
17 Refrigerant condensation temperature sensor
18 High pressure sensor
19 Air temperature sensor

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平6－347107

(43)公開日　平成６年(1994)12月20日

(51)Int.Cl.[5]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｆ２５Ｂ	1/00	３７１　Ｂ			
Ｂ０１Ｌ	7/00				
	11/02				
Ｆ２４Ｆ	11/02	１０２　Ｖ			

審査請求　未請求　請求項の数９　ＯＬ　（全 ７ 頁）

(21)出願番号　特願平5－137637

(22)出願日　平成５年(1993)６月８日

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最終頁に続く

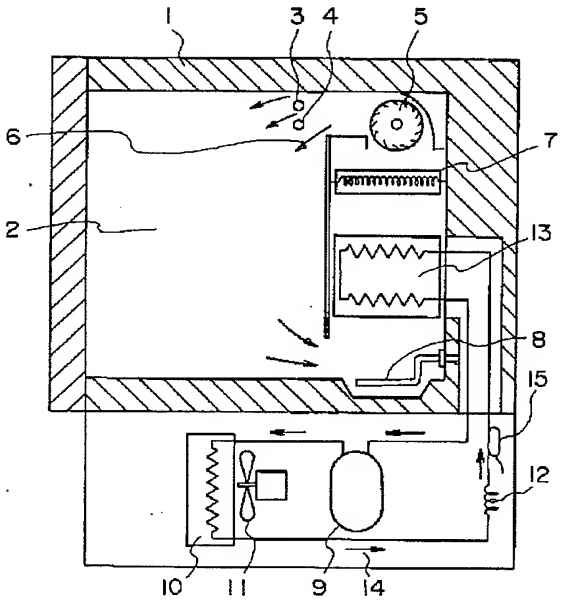
(54)【発明の名称】　恒温恒湿装置の冷凍機制御方法及び冷凍機制御装置

(57)【要約】

【目的】　装置周囲温度の変化による試験室温度制御の乱れ、特に最低到達可能温度性能の低下を防止する。

【構成】　室２内に設けた加温器７及び加湿器８により調温調湿制御するとともに、室２内に設けた蒸発器１３に圧縮機９を経由して凝縮手段１０，１１と減圧手段１２とを接続し室２内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法であって、回転数変化により冷却能力を可変にする圧縮機９を採用し、冷媒蒸発温度センサ１５を設け、センサ検出温度を目標値の冷媒蒸発温度に一定に保つように、圧縮機９の回転数変化のための周波数を演算制御する。

【効果】　冷媒蒸発温度を一定温度に維持して安定させることができ、試験室温度制御の安定化と、高精度化とが可能となる。



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【特許請求の範囲】

【請求項１】　断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき前記室内に設けた加温器及び加湿器により調温調湿制御するとともに、前記室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し前記室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、前記室内の温度及び湿度を入力して前記冷凍機の冷媒状態の目標値を設定し、該目標値と前記冷媒状態の測定値との差に応じて前記圧縮機をインバータにより回転数制御し、冷却能力を可変にすることを備えことを特徴とする恒温恒湿装置の冷凍機制御方法。

【請求項２】　断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき前記室内に設けた加温器及び加湿器により調温調湿制御するとともに、前記室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し前記室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、前記冷凍機の冷媒状態に応じて該冷媒状態の目標値をあらかじめ設定し、該目標値に応じて前記圧縮機をインバータにより回転数制御し、冷却能力を可変にすることを備えことを特徴とする恒温恒湿装置の冷凍機制御方法。

【請求項３】　断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき前記室内に設けた加温器及び加湿器により調温調湿制御するとともに、前記室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し前記室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、前記室内の温度及び湿度を入力して前記冷凍機の冷媒状態の目標値を設定し、該目標値と前記冷媒状態の測定値との差に応じて電子膨張弁で形成した前記減圧手段の開度を制御し、冷却能力を可変にすることを特徴とする恒温恒湿装置の冷凍機制御方法。

【請求項４】　冷媒状態は、減圧手段により減圧された冷媒のほぼ一定値に設定される冷媒蒸発温度であることを特徴とする請求項１～３のいずれか１項記載の恒温恒湿装置の冷凍機制御方法。

【請求項５】　冷媒状態は、圧縮機に吸入される冷媒の低圧圧力であることを特徴とする請求項１～３のいずれか１項記載の恒温恒湿装置の冷凍機制御方法。

【請求項６】　冷媒状態は、圧縮機より吐出されかつ凝縮手段で凝縮された冷媒の冷媒凝縮温度であることを特徴とする請求項１～３のいずれか１項記載の恒温恒湿装置の冷凍機制御方法。

【請求項７】　冷媒状態は、圧縮機より吐出された冷媒の高圧圧力であることを特徴とする請求項１～３のいずれか１項記載の恒温恒湿装置の冷凍機制御方法。

【請求項８】　冷媒状態の目標値は、凝縮手段の装置周囲温度に応じて設定されることを特徴とする請求項１～７のいずれか１項記載の恒温恒湿装置の冷凍機制御方法。

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【請求項９】　請求項１、２又は４～８のいずれか１項記載の恒温恒湿装置の冷凍機制御方法を適用する恒温恒湿装置の冷凍機制御装置において、制御手段に、圧縮機をインバータにより回転数制御し冷却能力を可変にする周波数制御器を備えたことを特徴とする恒温恒湿装置の冷凍機制御装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、恒温恒湿装置に係り、特に装置室内の温度及び冷媒蒸発温度に応じて冷凍機の圧縮機を回転数制御し、最適な冷却能力を供給して設定された温湿度を安定維持するのに好適な恒温恒湿装置の冷凍機制御方法及び冷凍機制御装置に関する。

【０００２】

【従来の技術】従来の恒温恒湿装置の冷凍機制御方法においては、冷凍サイクルの圧縮機に、回転数一定（固定）のものを搭載し、冷却及び除湿能力を切換えるには、減圧機構及び蒸発器を２種以上並列に装備し、必要に応じていずれか一方の減圧機構及び蒸発器に冷媒を流すことにより、冷却能力の調整を行うのが一般的であり、この種の装置に関連する公知例として実開昭６３－１３２２５２号公報がある。

【０００３】例えば半導体又は電子装置等を試験する恒温恒湿装置は、基本性能として試験室の到達可能な最低温度が決まっているが、この最低温度を達成するには試験室最低温度に対し、適切な温度差以下の冷凍サイクルの冷媒蒸発温度を維持する必要がある。従来のように、冷凍サイクルの減圧機構にキャピラリチューブ又は温度式膨張弁を用いると、装置周囲温度が高い、すなわち空冷凝縮器による冷媒凝縮温度が高い場合、冷媒蒸発温度も上昇して試験室最低温度の維持ができなくなり、設定した最低温度より上昇してしまう。しかしこれを防ぐため、冷媒凝縮温度が高い場合でも、必要な冷媒蒸発温度が得られるようにキャピラリチューブ又は温度式膨張弁の減圧量を決定すると、周囲温度が低く、冷媒凝縮温度が低い場合、冷媒蒸発温度が異常に低下し冷凍機油温度低下による圧縮機損傷の原因となる。従って、装置周囲温度の変化すなわち冷媒凝縮温度の変化に対し影響を受けない冷媒蒸発温度を維持し、年間を通して装置性能を一定に保つことがこの種の装置の重要な条件である。

【０００４】

【発明が解決しようとする課題】従来の恒温恒湿装置の冷凍機制御方法にあっては、装置周囲温度の変化、すなわち圧縮機の冷媒凝縮温度の変化に伴って冷媒蒸発温度が変化し、年間を通して装置性能を一定に保つことができない問題点があった。

【０００５】本発明の目的は、装置周囲温度が変化しても冷媒蒸発温度をほぼ一定値に維持し、室内を調温調湿することのできる恒温恒湿装置の冷凍機制御方法及び冷

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凍機制御装置を提供することにある。

【0006】

【課題を解決するための手段】前記の目的を達成するため、本発明に係る恒温恒湿装置の冷凍機制御方法は、断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき室内に設けた加温器及び加湿器により調温調湿制御するとともに、室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、室内の温度及び湿度を入力して冷凍機の冷媒状態の目標値を設定し、目標値と冷媒状態の測定値との差に応じて圧縮機をインバータにより回転数制御し、冷却能力を可変にする構成とする。

【0007】そして断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき室内に設けた加温器及び加湿器により調温調湿制御するとともに、室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、冷凍機の冷媒状態に応じて冷媒状態の目標値をあらかじめ設定し、目標値に応じて圧縮機をインバータにより回転数制御し、冷却能力を可変にする構成でもよい。

【0008】また断熱材に囲まれた室内の温度及び湿度を測定し、それぞれの測定値に基づき室内に設けた加温器及び加湿器により調温調湿制御するとともに、室内に設けた蒸発器に圧縮機を経由して凝縮手段と減圧手段とを接続し室内を所定温度に冷却させる冷凍機を制御する恒温恒湿装置の冷凍機制御方法において、室内の温度及び湿度を入力して冷凍機の冷媒状態の目標値を設定し、目標値と冷媒状態の測定値との差に応じて電子膨張弁で形成した減圧手段の開度を制御し、冷却能力を可変にする構成でもよい。

【0009】さらに冷媒状態は、減圧手段により減圧された冷媒のほぼ一定値に設定される冷媒蒸発温度である構成でもよい。

【0010】そして冷媒状態は、圧縮機に吸入される冷媒の低圧圧力である構成でもよい。

【0011】また冷媒状態は、圧縮機より吐出されかつ凝縮手段で凝縮された冷媒の冷媒凝縮温度である構成でもよい。

【0012】さらに冷媒状態は、圧縮機より吐出された冷媒の高圧圧力である構成でもよい。

【0013】そして冷媒状態の目標値は、凝縮手段の装置周囲温度に応じて設定される構成でもよい。

【0014】また恒温恒湿装置の冷凍機制御装置においては、前記いずれか一つの恒温恒湿装置の冷凍機制御方法を適用する恒温恒湿装置の冷凍機制御装置において、制御手段に、圧縮機をインバータにより回転数制御し冷却能力を可変にする周波数制御器を備えた構成とする。

【0015】

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【作用】本発明によれば、回転式圧縮機の電源周波数を変化させると、

回転数（r．p．m）＝（120／p）×f

p＝極数，　f＝周波数

で示されるように、周波数に比例して回転式圧縮機の回転数が変化する。回転数が変化すると冷媒の吐出量が変化して冷媒循環量が変化し、冷却能力が変化する。例えば装置周囲温度が高く、冷凍機の冷媒凝縮温度が高い場合、冷媒蒸発温度も高くなるが、周波数を高くして回転式圧縮機の回転数を上昇させると、冷媒循環量が増加して冷媒凝縮温度が低下し、所定の冷却能力が得られる。電源周波数は制御手段に入力される室内の測定温度により決定される目標冷媒蒸発温度に対して、測定冷媒蒸発温度を比較演算し、目標冷媒蒸発温度と測定冷媒蒸発温度とを近似させることにより、最適な冷却能力が供給されて装置周囲温度の変化による冷媒凝縮温度の変化に伴う冷却能力の変化が抑制され、装置性能が年間を通して一定に保たれる。

【0016】

【実施例】本発明の第1の実施例を図1を参照しながら説明する。図1に示すように、恒温恒湿装置は断熱層1により囲まれた試験室（室）2と、冷媒14を循環する周波数制御可能な回転式圧縮機9と、回転式圧縮機9より吐出した冷媒ガスを冷媒液に空気冷却する凝縮器10と凝縮器10に送風する凝縮器用送風機11とよりなる凝縮手段と、冷媒14を減圧する減圧機構（減圧手段）12と、試験室2内に設けられ減圧された冷媒14で試験室2内の熱を吸収する蒸発器13と、試験室2内を加温制御する加温ヒータ7と、試験室内を加湿制御する加湿ヒータ8と、試験室2内の循環送風機5と、図示しない制御手段とにより構成される。試験室2内を空気の流れ6が矢印図示のように循環している。循環送風機5の吹出口には乾球温度センサ3及び湿球温度センサ4が配置され、さらに減圧機構12の冷媒出口側で、蒸発器13までの配管系路に冷媒蒸発温度センサ15を取付けてある。なお圧縮機は定速のものを搭載し、減圧機構を電子膨張弁で形成した構成でもよい。

【0017】本装置の制御系路（制御手段）を図2を参照しながら説明する。乾球温度センサ3及び湿球温度センサ4の各々の検出温度は、室内の設定温度及び設定湿度との比較演算をマイクロコンピュータ20で行ない、ヒータ出力制御器21，22で加温ヒータ7及び加湿ヒータ8への出力信号をPID制御することにより、高精度の調温調湿制御を可能としている。これに対し、除湿冷却用として用いられる冷凍サイクルは、乾球温度センサ3及び湿球温度センサ4の各々の検出温度に基づき冷媒状態の目標値の設定と冷媒状態の測定値との差、例えば冷媒蒸発温度センサ15による検出温度と設定冷媒蒸発温度との差の比較演算をマイコン20で行い、周波数制御器23で回転式圧縮機の回転数を制御するための周

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波数をＰＩＤ制御している。なお冷媒状態は、圧縮機に吸入される冷媒の低圧圧力、圧縮機より吐出されかつ凝縮手段で凝縮された冷媒の冷媒凝縮温度、又は圧縮機より吐出された冷媒の高圧圧力のいずれでもよく、また設定冷媒蒸発温度等の目標値は室内の温度及び湿度に応じて装置の仕様上あらかじめ決められていてもよい。さらに減圧手段を電子膨張弁で形成して圧縮機は定速のものを搭載し、電子膨張弁をマイコンにより開度制御するようにしてもよい。

【００１８】回転式圧縮機の周波数制御のフローチャートを図３に示す。回転式圧縮機は電源周波数の変化に応じて回転数が変化し、冷媒循環量が増減するものであり、回転式圧縮機の運転開始と同時に初期設定周波数で回転し、これ以降は、常時、蒸発温度センサの測定温度と目標冷媒蒸発温度との差の比較演算を行い、測定温度が高い場合は周波数増とし、また低い場合は周波数減とし、さらに増減量はＰＩＤ制御することにより回転式圧縮機へ伝送する最適な電源周波数を決定し、測定冷媒蒸発温度を目標冷媒蒸発温度に近似させ、さらに一致させる運転が可能となる。

【００１９】本発明の第２の実施例を図４を参照しながら説明する。第１の実施例における冷媒蒸発温度センサのかわりに、冷凍サイクル低圧力センサを用いた構成である。減圧機構１２と蒸発器１３とを介して回転式圧縮機９との間に低圧圧力センサ１６を取付けることにより、第１の実施例における設定冷媒蒸発温度と検出温度との比較演算と同様に、目標低圧圧力と検出圧力との比較演算を行い回転式圧縮機の周波数を制御し、目標低圧圧力と検出圧力とを近似させることが可能となる。

【００２０】本発明の第３の実施例を図５を参照しながら説明する。第１の実施例における冷媒蒸発温度センサのかわりに、冷凍サイクル凝縮温度センサを用いた構成である。凝縮器１０の内部又は凝縮器１０の出口部に冷媒凝縮温度センサ１７を取付けることにより、冷媒凝縮温度を検出し、あらかじめ冷媒凝縮温度に対し冷媒蒸発温度を一定に保つために必要な回転式圧縮機の周波数を設定しておく。この制御例を図６に示す。第３の実施例により、装置周囲温度の変化に伴う冷媒凝縮温度の変化に応じた設定周波数で、回転式圧縮機を運転することにより冷媒蒸発温度を一定に保つことが可能となる。

【００２１】本発明の第４の実施例を図７を参照しながら説明する。第３の実施例における冷媒凝縮温度センサのかわりに、冷凍サイクル高圧圧力センサを用いた構成である。回転式圧縮機９と減圧機構１２との間に高圧圧力センサ１８を取付けることにより冷媒の高圧圧力を検出し、第３の実施例における検出した冷媒凝縮温度による回転式圧縮機の周波数設定のかわりに、検出した高圧圧力により周波数を設定することにより同一の効果を得ることができる。

【００２２】本発明の第５の実施例を図８を参照しながら説明する。第３の実施例における冷媒凝縮温度センサのかわりに空気温度センサを用いた場合を図８に示す。装置周辺部又は凝縮器１０の空気吸込部に空気温度センサ１９を取付けることにより、空気温度（装置周囲温度）を検出し第３の実施例における検出した冷媒凝縮温度による回転式圧縮機の周波数設定のかわりに、検出した空気温度により周波数を設定することにより同一の効果を得ることができる。

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【００２３】本発明により、装置周囲温度の変化、すなわち冷媒凝縮温度の変化に対して、冷媒蒸発温度を目標温度に維持し、安定させることができる。本発明による回転式圧縮機の周波数制御と冷凍サイクル特性の一例を図９に示す。本発明の冷媒蒸発温度による周波数制御を採用することにより、装置周囲温度が変化し、冷媒凝縮温度が変化しても、冷媒蒸発温度は設定冷媒蒸発温度である－４５℃を一定に保つことができ、この結果、試験室設定温度－４０℃を年間を通して維持し、安定を保つことが可能となる。なお、従来技術による周波数固定（６０Ｈｚ）の場合は、図９中に破線で示すように、装置周囲温度変化に対し、冷媒蒸発温度が変化し、この結果、周囲高温時試験室温度が－４０℃を維持することができなくなる。

【００２４】

【発明の効果】本発明によれば、装置周囲温度の変化、すなわち冷媒凝縮温度の変化に対して、冷媒蒸発温度を目標温度に維持し、安定させることができるため、室内の設定温度が年間を通して高精度に維持され、安定化することが可能となる。

【図面の簡単な説明】

【図１】本発明の第１の実施例を示す構成図である。

【図２】図１の制御系路を示すフローチャートである。

【図３】図１の回転式圧縮機の周波数制御を示すフローチャートである。

【図４】本発明の第２の実施例を示す構成図である。

【図５】本発明の第３の実施例を示す構成図である。

【図６】本発明実施例３による冷媒凝縮温度と設定圧縮機周波数

【図７】本発明の第４の実施例を示す構成図である。

【図８】本発明の第５の実施例を示す構成図である。

【図９】本発明による圧縮機周波数制御と冷凍サイクル特性とを示す図である。

【符号の説明】

３　乾球温度センサ
４　湿球温度センサ
７　加温ヒータ
８　加湿ヒータ
９　回転式圧縮機
１０　凝縮器
１２　電子式比例制御弁
１３　蒸発器

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14　冷媒
15　冷媒蒸発温度センサ
16　低圧圧力センサ

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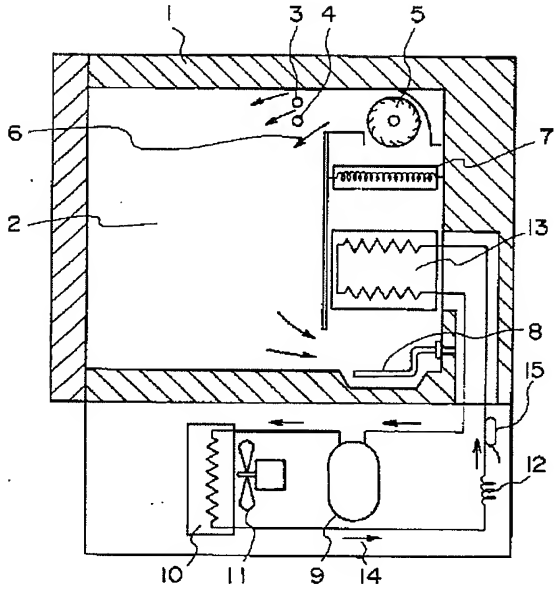
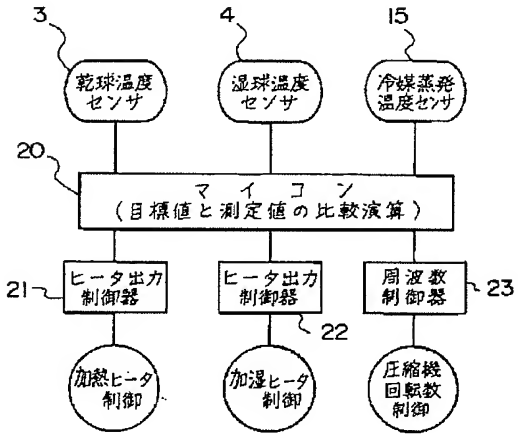
17　冷媒凝縮温度センサ
18　高圧圧力センサ
19　空気温度センサ

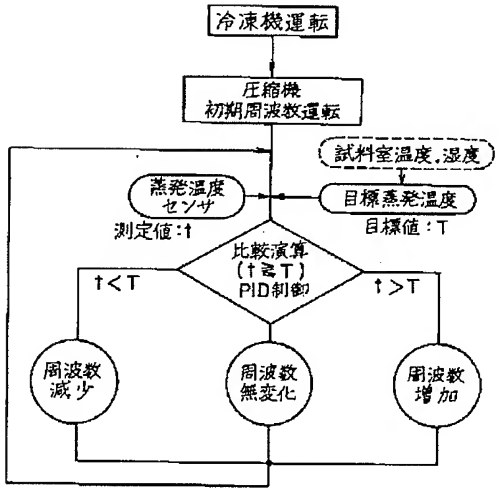
【図1】



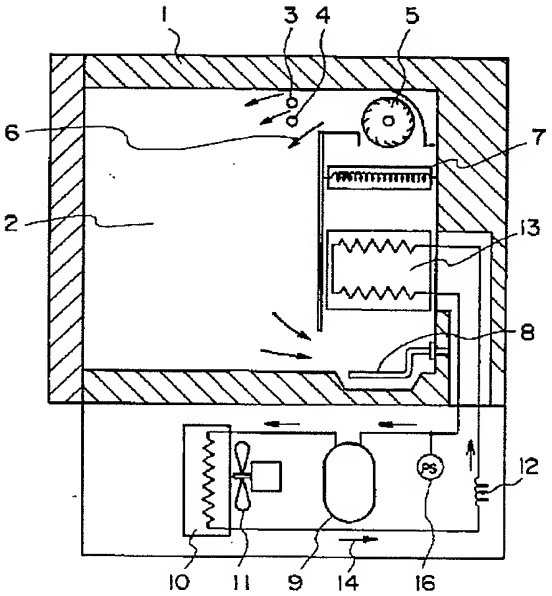
【図2】



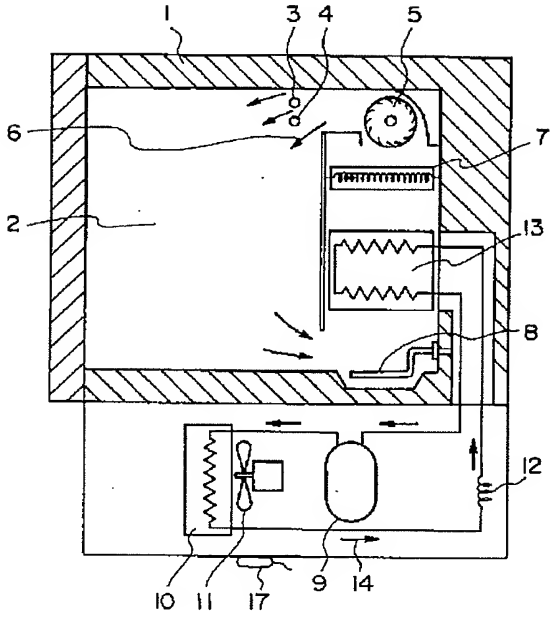
【図3】



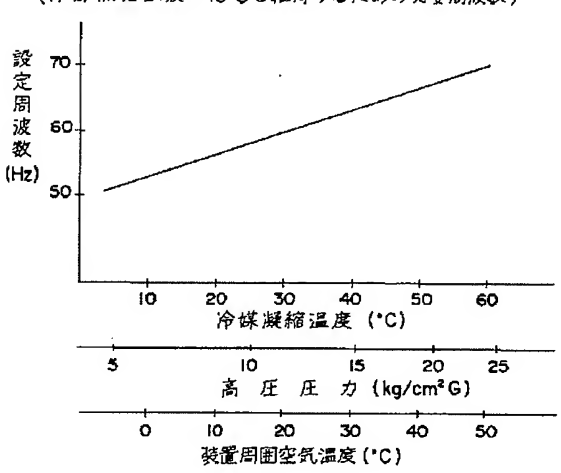
【図4】



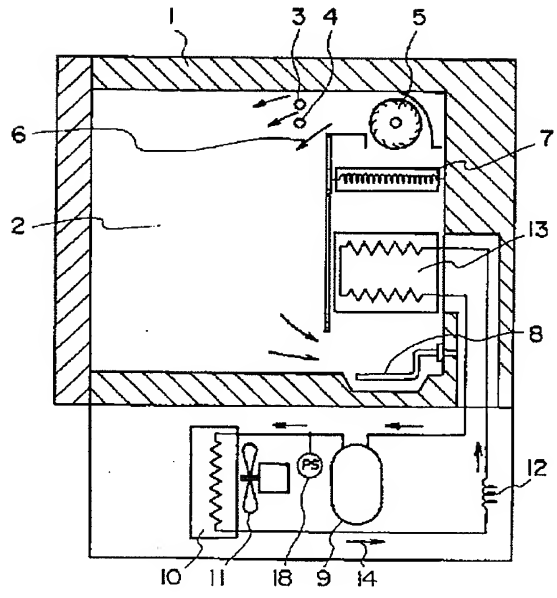
【図5】


1
3
4
5
6
7
2
13
8
12
10
11
17
9
14

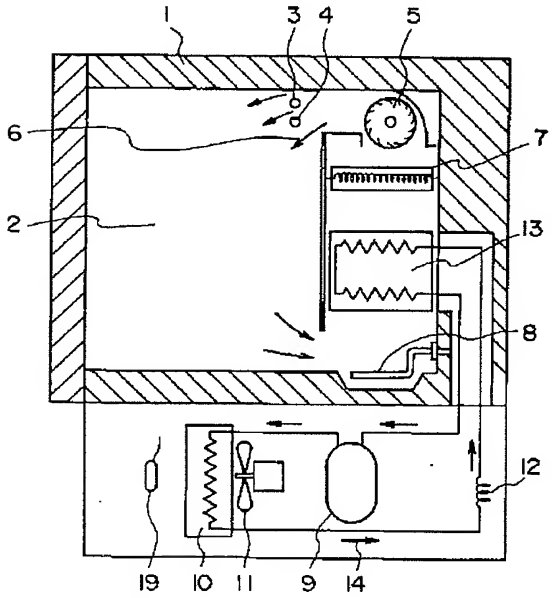
【図6】


（冷媒蒸発温度-45℃を維持するための必要周波数）
設定周波数 (Hz)
70
60
50
10
20
30
40
50
60
冷媒凝縮温度 (°C)
5
10
15
20
25
高圧圧力 (kg/cm²G)
0
10
20
30
40
50
装置周囲空気温度 (°C)

【図7】


1
3
4
5
6
7
2
13
8
12
PS
10
11
18
9
14

【図8】


1
3
4
5
6
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2
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19
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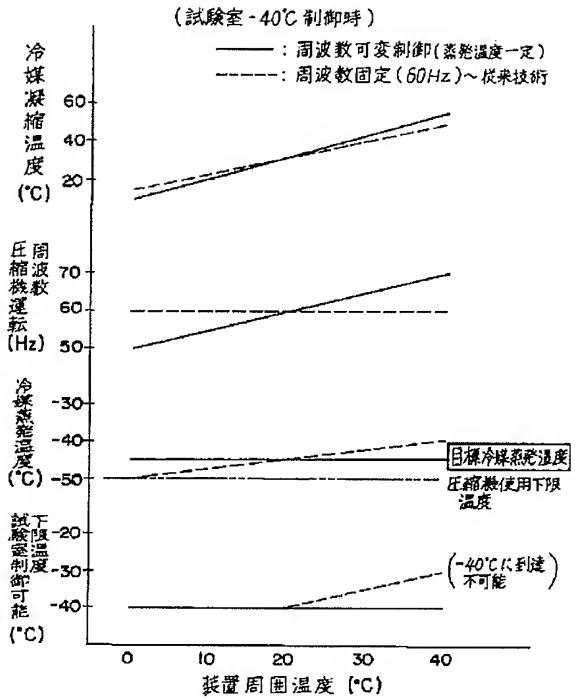
14

【図９】



フロントページの続き

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